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Joseph John Sumakeris

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EXAMINER

DHINGRA, RAKESH KUMAR

ART UNIT

PAPER NUMBER

1763

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/714,214	Applicant(s) SUMAKERIS ET AL.	
	Examiner Rakesh K. Dhingra	Art Unit 1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 June 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 6/19/06 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date: _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date: _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 2 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention as explained hereunder.

Claim 2 recites interalia – “a first liner ----- and the processing chamber” and “a second liner ---- and the processing chamber”, which are indefinite limitations, since claim 2 does not recite if the first and the second liners are separate from liner recited in claim 1, or these are parts of the liner recited in claim 1 (as shown in Figures 1, 2, 4 of applicant’s disclosure). For the purpose of examination on merits, this limitation of claim 2 has been interpreted as –“and where the liner comprises, “a first liner ----- and the processing chamber” and “a second liner ---- and the processing chamber”.

Applicant is invited to clarify/amend the claim.

Response to Arguments

Applicant’s arguments with respect to claims 1-12 have been considered but are moot in view of the new ground(s) of rejection as explained hereunder.

Applicant has amended independent claim 5 by adding new limitations “a housing assembly defining a processing chamber and including” and “an EMF generator configured to generate an electromagnetic field to induce eddy currents within the susceptor, wherein the susceptor converts the eddy currents to heat”. Further, applicant has also added limitation “heating device” in the preamble of all claims 1-12.

Accordingly claims 1-12 are now pending and active.

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New reference (US Patent No. 5,879,462 – Kordina et al) when combined with Leycuras and Rupp et al reads on amended claim 5 limitations. Accordingly claims 1, 2, 5-7 have been rejected under 35 USC 103 (a) as explained below. Balance claims 3, 4 and 8-12 have also been rejected under 35 USC 103 (a) as explained below.

Further, response to applicant's arguments is given hereunder.

1) Applicant argues that in Leycuras reference, duct 6 is merely a thermally conductive liner and not a susceptor, and Leycuras does not teach or suggest the the provision of an electromagnetic field (EMF) generator that generates an EMF field that induces eddy currents in the duct 6, which eddy currents the duct 6 converts to heat, and thus the duct 6 is fundamentally different in purpose and function than the susceptor as recited in Claim 5. Accordingly, the coating to which the office action refers is not a coating on a susceptor that corresponds to the susceptor as now recited in Claim 5.

Examiner responds that Leycuras teaches heating of substrate 10 by heat radiated from the duct 6, which in turn is heated by resistive heating means 8 and 9, that is "the duct 6 absorbs externally supplied energy and re-transmits the same to a substrate" and thus functions as a susceptor. Leycuras further teaches that instead of resistive heating means, inductive heating means could also be used for heating the duct, which teaching is corroborated by new reference (Kordina et al), as per claim 5 limitation, as explained below.

2) Applicant further argues that there is no apparent suggestion to use duct 6 as an EMF-to-heat converting susceptor of an induction heating device, and an ordinarily skilled artisan without benefit of Applicants' specification would interpret the cited disclosure to suggest that the resistive elements 8, 9 would be replaced with an EMF generator and susceptors, and the duct 6 would still be only a thermally conductive element heated by the susceptors of the heating means 8, 9, not a part of the first and second heating means.

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Examiner responds that Leycuras teaches heating means 8, 9 and do not disclose these as susceptors. As explained above, duct 6 acts as a susceptor by transmitting the heat absorbed (from heating means 8, 9) to the substrate 10. Further, as indicated in last office action also, Leycuras also teaches that instead of heating means 8, 9 (resistive heaters), inductive heating means could be alternatively used. Thus it would be obvious to one of ordinary skills in the art to use inductive heating means in Leycuras apparatus, by use of an EMF generator for inducing eddy currents in the susceptor (duct 6), as taught by Kordina et al.

3) Applicant's argument that Leycuras appears to teach away from the use of the duct 6 as an EMF-to-heat converting susceptor (*see, e.g.*, col. 1, lines 22-48), as indicated in the background section of reference, is not found persuasive, since Leycuras teaches use of inductive heating means for his disclosed invention by which duct 6 would be subjected to electromagnetic field and in turn would heat the substrate 9 that is, duct 6 functions as a susceptor.

4) Responding to applicant's argument that duct 6 by design, extends well beyond the deposition zone and using the duct 6 as an induction susceptor would presumably undesirably alter the thermal distribution, examiner responds that since Leycuras has not disclosed details of induction heating means, Kordina reference is used that teaches use of EMF generator for inducing eddy currents in susceptor for heating the same as per claim limitation, as also explained below.

5) Applicant argues that Rupp does not suggest the modification to Leycuras as proposed by the office action and that Rupp does not suggest the use of a coating of a refractory metal carbide on a susceptor core, wherein a liner is interposed between the coating and the processing chamber.

Examiner responds that Rupp teaches use of Tantalum as a preferred material for forming carbide coating on graphite insert prevent impurity being introduced into silicon carbide by the carbide cations. Thus use of such a coating would be applicable (including on a susceptor) in SiC processing

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environments (column 5, lines 1-50). Further, Leycuras does not explicitly teach that duct walls are not coated when a liner is present.

6) Responding to applicant's argument that since Leycuras teaches SiC and AlN as preferred coatings on his apparatus, and further since Leycuras teaches that coating on susceptor walls can be a material that is to be coated on the substrate, Leycuras arguably teaches away from the proposed modification with Rupp where a TaC coating is done on a graphite base, the examiner responds that Leycuras does not expressly teach that only coatings of metal carbides other than SiC or AlN can be done and other coatings like TaC can not be done on the apparatus.

7) Regarding applicant's contention that the insert 2 of Rupp has no apparent correspondence or relation to the duct 6 of Leycuras, which is separated from contact with the substrate 10 by not only the substrate holder 29, but also by the liner 70, examiner responds that Rupp reference is used since the same teaches use of TaC coating on graphite based substrates in SiC growth processing environments. Further, the motivation statement for combining Rupp with Leycuras has been reconsidered and amended as indicated below.

8) applicant's argument that in Mezey, the heat shield 70 does not interface with process chamber is found persuasive. However, Mezey further teaches a velocity gradient plate 150 (liner) {Figure 4} that interfaces with processing chamber and is made from silicon carbide, as explained below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention

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was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 2, 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Leycuras (US Patent No. 6,709,520) in view of Kordina et al (US Patent No. 5,879,462) and Rupp et al (US Patent No. 6,740,167).

Regarding Claim 5, 6: Leycuras teaches an apparatus (Figures 1-5) comprising:

a tube 3 (housing assembly) defining a processing chamber and including:

a) a duct (as a susceptor) 6 made from graphite and surrounding at least a portion of the processing chamber; and

b) a secondary duct (thermally conductive liner) 70 interposed between the duct (susceptor) 6 and the processing chamber, wherein the secondary duct (liner) 70 is separately formed from the duct (susceptor) 6;

c) the inner surface of susceptor walls 37, 38 can be coated (that is susceptor would have a core material and a coating material){column 4, lines 45-55}. Thus the liner 70 will be disposed between the susceptor coating and the processing chamber;

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Leycuras also teaches heating of substrate by heat radiated from the duct 6, which in turn is heated by resistive heating means 8 and 9. Leycuras further teaches that instead of resistive heating means, inductive heating means could also be used for heating the duct.

Leycuras does not teach an EMF generator configured to generate an electromagnetic field to induce eddy currents within the susceptor, wherein the susceptor converts the eddy currents to heat and also do not explicitly teach that coating (second material) is made from refractory metal carbides.

However, use of emf generator for generating electromagnetic field to induce eddy currents within the susceptor for converting into heat are known in the art, as per reference cited hereunder.

Kordina et al teach a heating device comprising a susceptor 7 which is heated by electromagnetic field radiated by a RF coil 9 (emf generator) {eddy currents would be inherently induced within the susceptor, which get converted to heat} [for example, Figures 1-3 and column 5, line 1 to column 6, line 50}.

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to use inductive heating means comprising an emf generator for heating the susceptor by eddy currents as taught by Kordina et al in the apparatus of Leycuras to enable heat the susceptor as an equivalent heating means for heating the substrate.

In this connection courts have ruled:

“An express suggestion to substitute one equivalent component or process for another is not necessary to render such substitution obvious. *In re Fout*, 675 F.2d 297, 213 USPQ 532 (CCPA 1982).”

Further, Leycuras in view of Kordina et al do not explicitly teach that coating (second material) is made from refractory metal carbides. However use of TaC as a coating on graphite base is known in the art for use in high temperature processing where SiC growth on substrates takes place, as per reference cited hereunder.

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Rupp et al teach an apparatus (Figures 1-4) for processing wafers comprising a susceptor 1 that has an insert 2 for supporting a semiconductor substrate 3. Rupp et al further teach that insert 2 has a core 11 made from graphite, and it is then coated with a metal carbide layer 6 made from metals like tantalum, niobium etc (refractory metals) [column 2, line 35 to column 3, line 20 and column 4, line 45 to column 5, line 52].

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a susceptor with a graphite core material and coated with a carbide coating of refractory metals like TaC, as taught by Rupp et al in the apparatus of Leycuras in view of Kordina et al to obtain susceptor that is stable at high temperatures and also does not introduce any impurity into the processing environment (column 5, lines 2-17).

Regarding Claim 1: Leycuras teach that the secondary duct (liner) 70 is removable from the susceptor without requiring disassembly of the duct (susceptor) 6 {column 9, lines 62-67}.

Regarding Claim 2: Leycuras teaches that apparatus comprises:

lower and upper walls (a first susceptor portion and a second susceptor portion) 37, 38 disposed on opposed sides of the processing chamber;

a secondary duct (first liner) 70 disposed between the first susceptor portion and the processing chamber; and

another secondary duct (second liner) 70 disposed between the second susceptor portion and the processing chamber (Figure 5 and column 9, line 62 to column 10, line 5).

Regarding Claim 7: Leycuras teach that the duct (susceptor) 6 is made of graphite (that is susceptor core - a first material) [column 3, line 30- column 7, line 25 and column 8, line 62 to column 10, line 5].

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Claims 3, 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Leycuras (US Patent No. 6,709,520) in view of Kordina et al (US Patent No. 5,879,462) and Rupp et al (US Patent No. 6,740,167) as applied to claims 1, 2 and 5-7 and further in view of Berkman et al (US Patent No. 3,845,738).

Regarding Claim 3: Leycuras in view of Kordina et al and Rupp et al teaches all limitations of the claim (as explained above under claim 5) including that the duct (susceptor) 6 includes a platter region (portion underlying the substrate holder 29) and a substrate holder (platter) 29 adapted to support the wafer 10 and overlying the platter region (Figure 1).

Leycuras in view of Kordina et al and Rupp et al does not teach an opening in the liner and overlying the platter region.

Berkman et al teach an apparatus (Figure 3) that includes a susceptor 72 with a shield (liner) 74 and wherein the shield (liner) 74 has plurality of openings 80, 82 that lie over a platter region (portion lying within the openings) of susceptor 72 (column 4, lines 13-45).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a liner with opening as taught by Berkman et al in the apparatus of Leycuras in view of Kordina et al and Rupp et al to enable accommodate wafers surrounded by the heat shield (liner) and to minimize deposition of reaction products on the susceptor surface (column 1, lines 15-65).

Regarding Claim 8: Berkman et al teach that platter region is exposed through the openings 80, 82 in the shield (liner) [Figure 3].

Regarding Claim 9: Berkman et al teach raised portions 84, 86 (like platters) disposed within the openings 80, 82 in the shield (liner) 74 [column 4, lines 13-40].

Regarding Claim 10: Leycuras teaches that substrate holder 29 can rotate the substrate 10 (with respect to susceptor 6) {column 9, lines 35-45}.

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Claims 4 & 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Leycuras (US Patent No. 6,709,520) in view of Kordina et al (US Patent No. 5,879,462) and Rupp et al (US Patent No. 6,740,167) as applied to claims 1, 2, 5-7 and further in view of Glass (US Patent No. 5,667,587).

Regarding Claim 4: Leycuras in view of Kordina et al and Rupp et al teaches all limitations of the claim (as explained above under claim 5) including a liner 70 that is formed separately from the susceptor.

Leycuras in view of Kordina et al and Rupp et al does not teach that liner varies in thickness along at least a portion of its length.

Glass et al teaches an apparatus (Figures 2-5) that includes a growth cavity 32 with a liner 36. Glass et al further teaches that liner 36 can have variable thickness along its length (Figure 5 and column 2, line 20 to column 3, line 30).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a liner with variable thickness as taught by Glass et al in the apparatus of Leycuras in view of Kordina et al and Rupp et al to enable obtain variable heating means in the process chamber.

Regarding Claim 11: Leycuras teaches that liner (secondary duct) 70 is in contact with duct (susceptor) 6 via grooves in duct 6 (Figure 5 and column 9, lines 62-65).

Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Leycuras (US Patent No. 6,709,520) in view of Kordina et al (US Patent No. 5,879,462) and Rupp et al (US Patent No. 6,740,167) as applied to Claims 1, 2, 5-7 and further in view of Mezey (US PG PUB 2001/0 046768).

Regarding Claim 12: Leycuras in view of Kordina et al and Rupp et al teaches all limitations of the claim including that liner 70 is formed from refractory material like graphite (column 5, lines 1-15).

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Leycuras in view of Kordina et al and Rupp et al does not explicitly teach that liner is made from silicon carbide.

Mezey teach an apparatus for semiconductor processing (Figure 4) comprising:

A processing volume including a velocity gradient plate 150 (liner) that defines channel for gas flow near substrate and where the velocity gradient plate is made from silicon carbide (paragraph 0076-0080).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a liner made from silicon carbide as taught by Mezey in the apparatus of Leycuras in view of Kordina et al and Rupp et al, to enable use a liner that is compatible with SiC processing environment and also provide control of gas flow volume near substrate and improve uniformity of deposited layer) [paragraph 0082].

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rakesh K. Dhingra whose telephone number is (571)-272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Rakesh K. Dhingra



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